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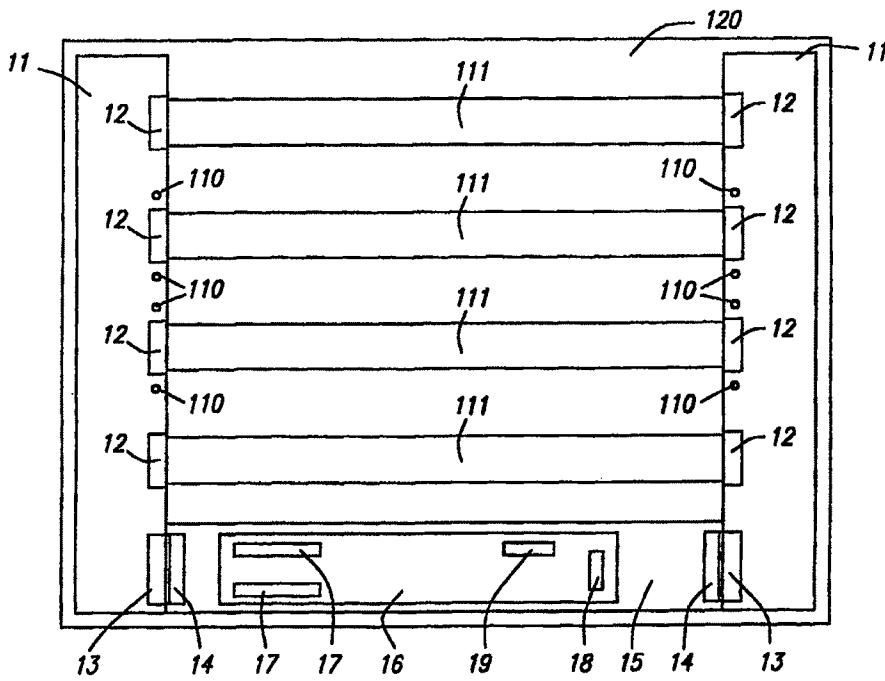
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(54) Title: LIGHTING APPARATUS



## (57) Abstract

Lighting apparatus such as a luminaire or illuminated sign comprises at least one bus bar (11). The at least one bus bar (11) comprises printed wiring and is connected to control means (15) of the apparatus. Power is fed to a lamp (111) via the printed wiring, which avoids the need for complex discrete wiring connections.

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LIGHTING APPARATUS

The present invention relates to lighting apparatus, and in particular luminaires and illuminated signs.

The normal method of wiring all the necessary connections within luminaires or illuminated signs is to take discrete wiring from a terminal block into which main power is being fed from an outside wired source and distributing this power to the lamp holders. Increasingly, in smaller lighting fixtures, the distribution of connections in this way involving multiple lamp systems is both time consuming during manufacture and in lighting maintenance. This problem is increased when, as is now common, the conventional installation of choke and starter is substituted by a high frequency controller requiring an increase in the number of connections to be made.

This process of wiring is cumbersome and inefficient and results in higher production costs because of increased labour time in inserting the many wires involved in the system, the preparation of the wires for insertion, and the quality control inspection needed to ensure that they have been correctly secured. Furthermore, the mass of wiring generally found within a unit absorbs a great deal of the light output of the lamps and reduces the downward light output.

This is further exaggerated within the maintenance programme if component parts have to be replaced. High frequency controllers are reliable and have substantial meantime between failures. However, like all electronic equipment, although the average meantime between failures may be long, failures do occur. A small percentage of failures occur early in the life of the lighting fixture. The cost of replacement of the high frequency controller and removal and re-insertion of all the wires involved is high.

This invention seeks to improve the utilisation of

space by producing a more efficient method of wiring and to reduce the cost of lighting maintenance.

The present invention provides lighting apparatus for receiving a lamp, comprising power input means for connection to a power supply, control means for controlling the current fed to said lamp, and at least one busbar comprising printed wiring, the at least one bus bar being connected to the output of the control means and connectable to said lamp to feed power thereto via the printed wiring.

Preferably, the at least one bus bar is selectively detachable from the apparatus.

These bus bars can be clicked immediately into place and may reduce manufacturing assembly times by a factor of 4 to 10.

In the event of failures, such a bus bar or components connected thereto can be easily removed and replaced within a very short time, thus greatly reducing on site maintenance costs.

Strong economic benefits which result from the replacement of discrete wiring by a bus bar system.

- 1) Reduction of factory labour and assembly costs;
- 2) By reducing the minute value time of production, greater output can be produced from the same factory space;
- 3) Maintenance costs may be significantly lowered;
- 4) Quality control may be improved;
- 5) Less light will be absorbed and light output transmissions are improved. Because of the more compact nature of the bus bar, it is possible to design slimmer, neater luminaires with consequently greater commercial market appeal.

In the design of luminaires or illuminated signs that require multiple fluorescent lamps, this invention enables replacement of all conventional wiring for connecting fluorescent lamps to control equipment, i.e. conventional switch start circuitry (choke, starter and

power factor correction capacitor) or a high frequency electronic ballast, to be replaced by bus bars that can be manufactured as component sub-assemblies.

In a preferred embodiment, a portion of the surface of the at least one bus bar is covered by a light reflective material. By removing a large volume of wiring and substituting bus bars therefor that are covered in a reflective material, the light output efficiency of the units can be greatly enhanced.

The at least one bus bar may be in the form of a printed circuit formed on either flexible or rigid material. Also the at least one bus bar may provide connections for the transfer of data and/or control signals between difference components of the apparatus. In addition, the apparatus may include emergency lighting circuitry, the at least one bus bar providing connections to feed power and/or control signals thereto.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows a multiple fluorescent lamp luminaire or sign in accordance with the invention, using a high frequency ballast control unit;

Figure 2 shows a multiple fluorescent lamp luminaire or sign using an inductor starter and a power factor correction capacitor;

Figure 3 shows a bus bar system with possible options for controls, sensors and monitoring systems; and

Figure 4 shows a bus bar system for large sign or luminaire systems using flexible printed circuit connections.

Referring to the bus bar system shown in Figure 1, this shows a luminaire configuration for four fluorescent lamps 111 operating from an electronic high frequency controller 16. The mains supply input is directly wired into a three way terminal block 18 mounted on the high frequency controller 16, and protected by a fuse 19.

The lamp connectors 12 are directly connected to the bus bar 11. Bus bars 11 as illustrated have a range of options to configure this luminaire as a four, three, two or one lamp 120 luminaire by using other fixing positions 110 for lamp connectors 12. This shows a typical lamp configuration for 600 mm x 600 mm luminaires that may vary from 4 lamp units down to 2 lamp units, however there is no limit on the number of possible lamps 11 that may be connected on a bus bar 11 system. A large number of lamps may well be required in a large illuminated sign.

Two bus bar units 11 are used in the illustrated luminaire to provide connections to fluorescent lamps 111, one on the left and the other on the right, lamps 111 being plugged into the lamp connectors 12 between the two bus bars 11. However, a single bus bar unit only may be required to connection to lamps having both terminals at one end thereof.

An interconnecting printed circuit board 15 is connected through plug 13 on each of the bus bar units 11 which plugs into sockets 14 mounted at each end of the interconnecting printed circuit board 15. This connects all the necessary lamp connections to the high frequency controller 16 through connector plugs 17. The high frequency controller 16 only needs to be plugged into the interconnecting printed circuit board to be installed into the luminaire or sign, during manufacture or installation. In the manufacture of a luminaire all the necessary connections and lamp connectors are manufactured as bus bar 11 and interconnecting printed circuit board 15 sub-assemblies, with the high frequency controller 16 as a separate unit that plugs into the interconnecting printed circuit board 15.

With this system it is now possible to manufacture a luminaire or sign with no internal discrete wiring, all connections are now manufactured as sub-assemblies. The sub-assemblies, including the bus bar units 11, may be fitted into the luminaire as a kit of parts at the point of

installing the luminaire or sign unit.

Figure 2 shows bus bar techniques adopted in a conventional switch start luminaire or sign using chokes, starters and power factor capacitors. The choke 121, starters 122 and capacitor 123 are assembled onto the interconnecting printed circuit board 15 and connected to bus bars 11 via connectors 14 and 13.

Controls, sensors and monitoring devices may be integrated into the bus bar system as shown in Figure 3. For example, passive infrared control 124, photo cell control 125, variable energy control 126, air quality sensors 127, lamp light level monitor 128, smoke detector 129, heat detector 130, infrared receivers and transmitters 131 and radio telemetry systems 134 may be selectively incorporated.

If the above options were added to standard luminaire units, both manufacturing and maintenance would become very expensive. However, by using bus bar techniques, this allows luminaires and signs to become very sophisticated systems in their own right. These options can be produced as complex sub-assemblies that can be easily integrated in the luminaire and sign systems, thus reducing manufacturing and maintenance costs. Also luminaires can be up-graded as required on site by substituting different bus bars and/or components.

Figure 4 shows the use of flexible printed circuit connections 135 between the bus bars 11, and the control unit 15 which may be appropriate in large luminaires or signs. Also, an additional flexible printed circuit connection 136 may be connected where required to the bus bar 11 by connectors 137. Emergency lighting control systems could also be integrated into the bus bar design concept where needed in luminaires.

With electronic control units, additional starting components may be required for fluorescent tube heaters. These may be fitted into the bus bar 11 sub-assembly.

CLAIMS

1. Lighting apparatus for receiving a lamp, comprising power input means for connection to a power supply, control means for controlling the current fed to said lamp, and at least one bus bar comprising printed wiring, the at least one bus bar being connected to the output of the control means and connectable to said lamp to feed power thereto via the printed wiring.
2. Apparatus of Claim 1 comprising two bus bars, each connectable to a respective terminal and said lamp.
3. Apparatus of Claim 1 or Claim 2 wherein the at least one bus bar is selectively detachable from the apparatus.
4. Apparatus of Claim 3 wherein the at least one bus bar detachably engages connections to the control means.
5. Apparatus of any preceding claim wherein a portion of the surface of the at least one bus bar is covered by a light reflective material.
6. Apparatus of any preceding claim wherein the at least one bus bar is configured to receive different numbers of lamps in spaced arrangements along the bar.
7. Apparatus of any preceding claim wherein the at least one bus bar is in the form of a printed circuit.
8. Apparatus of Claim 7 wherein the printed circuit is formed on flexible material.
9. Apparatus of any preceding claim wherein the control means comprises a printed circuit board and a high frequency controller to control the current fed to at least

one gaseous discharge lamp, the controller being selectively detachable from the circuit board.

10. Apparatus of any preceding claim adapted for selective connection to additional circuits which provide control and/or sensing functions.

11. Apparatus of any preceding claim wherein the at least one bus bar provides connections for the transfer of data and/or control signals between different components of the apparatus.

12. Apparatus of any preceding claim including emergency lighting circuitry, the at least one bus bar providing connections to feed power and/or control signals thereto.

13. Apparatus of any preceding claim in the form of a luminaire.

14. Apparatus of any preceding claim in the form of an illuminated sign.

**AMENDED CLAIMS**

[received by the International Bureau on 23 September 1998 (23.09.98);  
original claims 1-14 replaced by amended claims 1-13 (2 pages)]

1. Lighting apparatus for receiving a plurality of lamps, comprising power input means for connection to a power supply, control means for controlling the current fed to said lamp, and at least one bus bar comprising printed wiring, the at least one bus bar being connected to the output of the control means and connectable to said lamps to feed power thereto via the printed wiring, and configured to receive different numbers of lamps using different respective spaced arrangements of fixing positions along the bar.
2. Apparatus of Claim 1 comprising two bus bars, each connectable to a respective terminal of said lamp.
3. Apparatus of Claim 1 or Claim 2 wherein the at least one bus bar is selectively detachable from the apparatus.
4. Apparatus of Claim 3 wherein the at least one bus bar detachably engages connections to the control means.
5. Apparatus of any preceding claim wherein a portion of the surface of the at least one bus bar is covered by a light reflective material.
6. Apparatus of any preceding claim wherein the at least one bus bar is in the form of a printed circuit.
7. Apparatus of Claim 6 wherein the printed circuit is formed on flexible material.
8. Apparatus of any preceding claim wherein the control means comprises a printed circuit board and a high frequency controller to control the current fed to at least one gaseous discharge lamp, the controller being

selectively detachable from the circuit board.

9. Apparatus of any preceding claim adapted for selective connection to additional circuits which provide control and/or sensing functions.

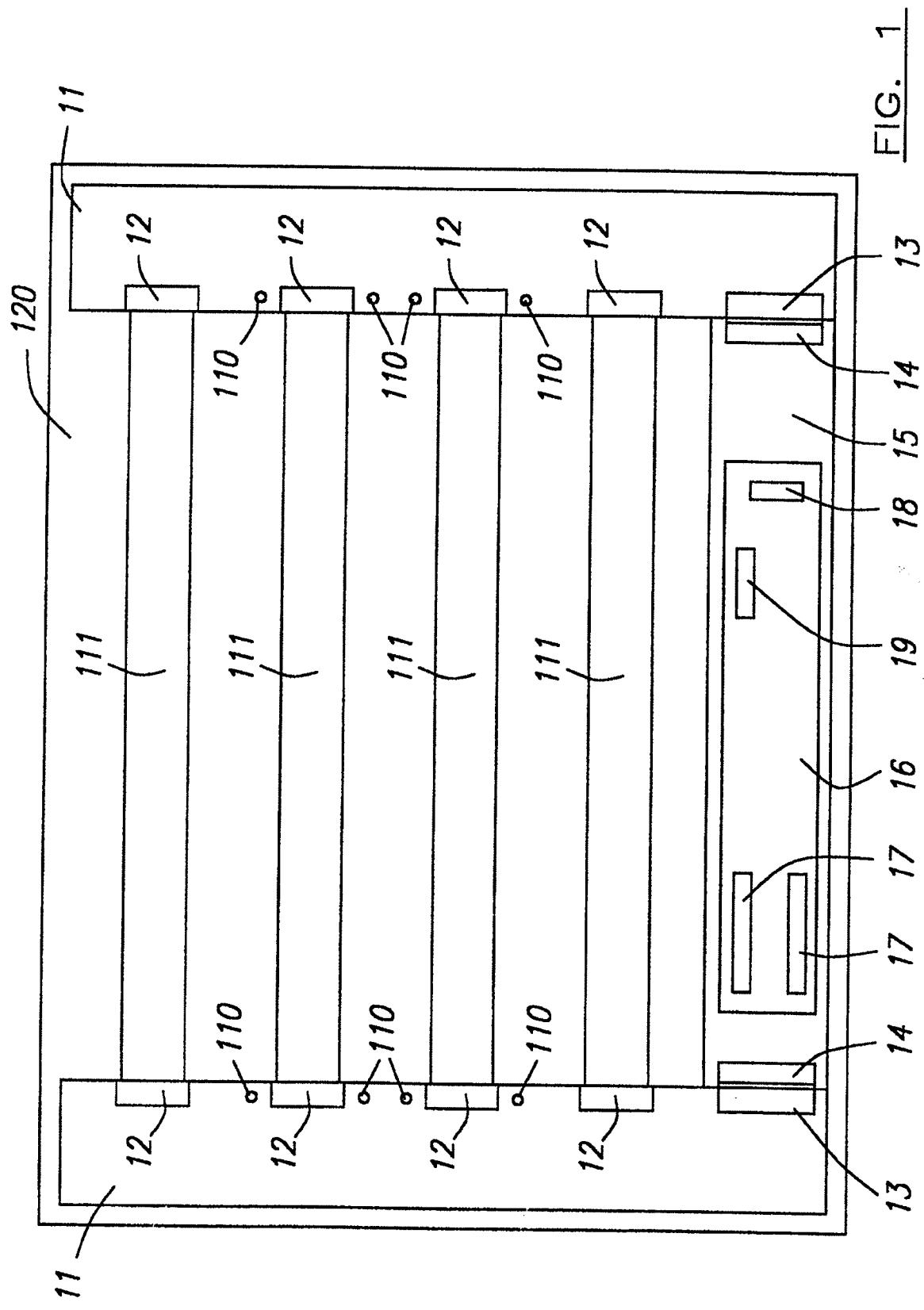
10. Apparatus of any preceding claim wherein the at least one bus bar provides connections for the transfer of data and/or control signals between different components of the apparatus.

11. Apparatus of any preceding claim including emergency lighting circuitry, the at least one bus bar providing connections to feed power and/or control signals thereto.

12. Apparatus of any preceding claim in the form of a luminaire.

13. Apparatus of any preceding claim in the form of an illuminated sign.

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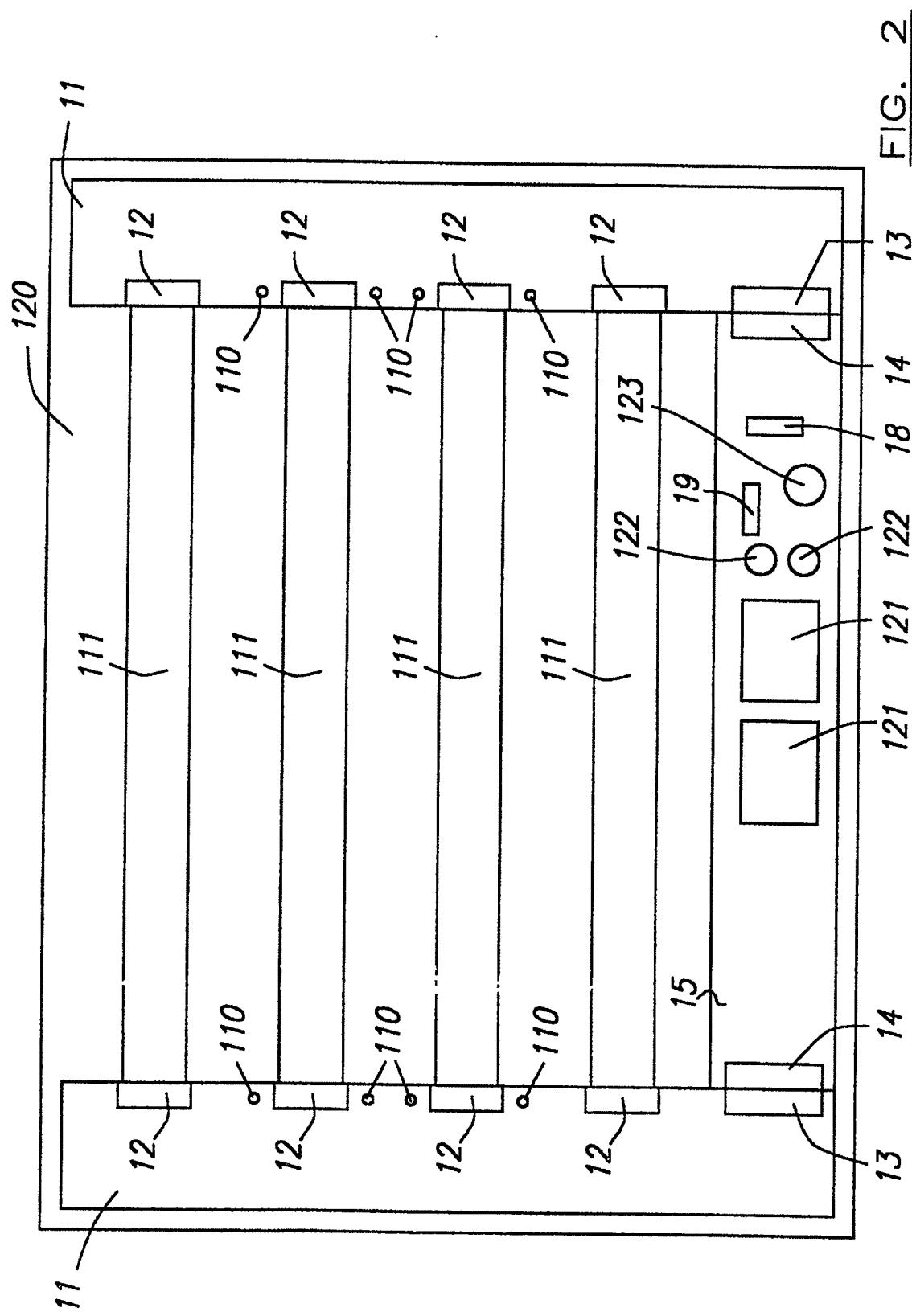
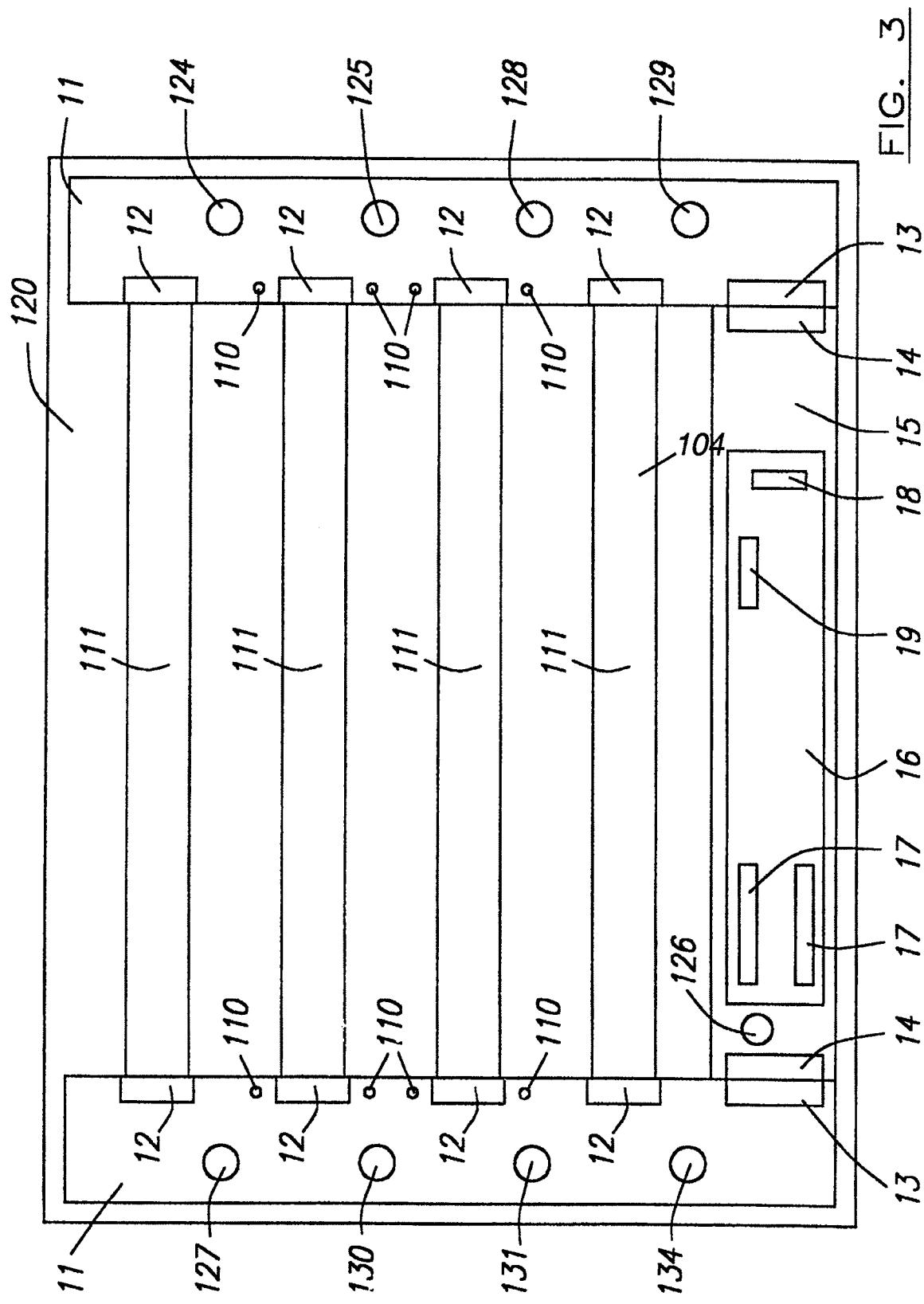
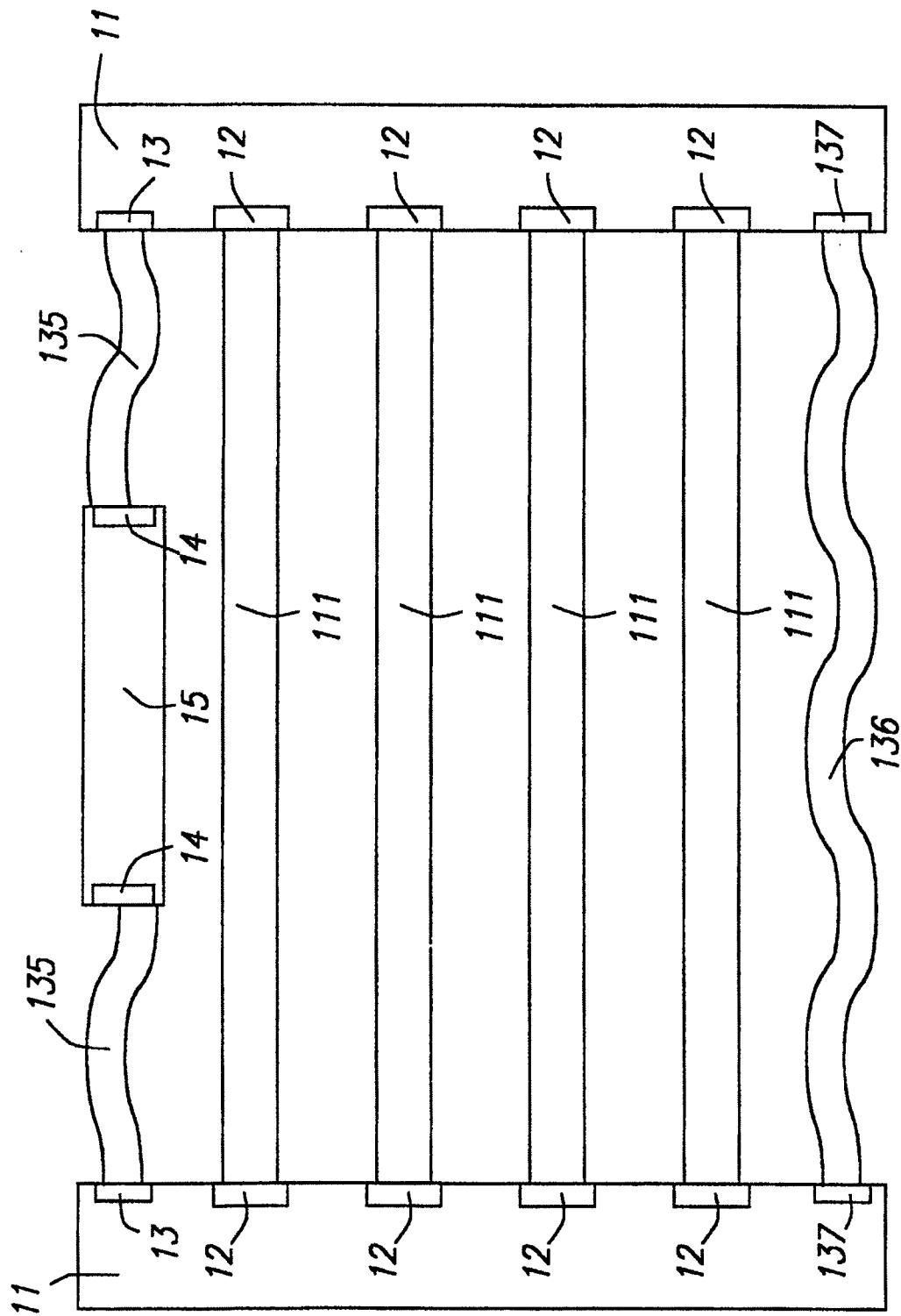


FIG. 2

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FIG. 4

# INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 98/01062

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 F21V23/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 F21V F21S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 504 891 A (MAZIS) 12 March 1985  see column 1, line 8 - line 13 see column 1, line 29 - line 59 see column 2, line 65 - column 4, line 43 see figures 1-13 ---	1-4, 6-8, 10, 11, 13, 14
X, P	US 5 720 546 A (CORREL, JR. ET AL.) 24 February 1998 see column 3, line 18 - line 33 see figures 1-4 ---	1-4, 6-11, 13
X	EP 0 035 747 A (SIEMENS AG) 16 September 1981 see page 2, line 23 - page 3, line 25 see figures 1,2 ---	1 -/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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**INTERNATIONAL SEARCH REPORT**International Application No  
PCT/GB 98/01062**C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 013 253 A (AIELLO ET AL.) 7 May 1991 see the whole document -----	1

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

national Application No  
PCT/GB 98/01062

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US 4504891	A 12-03-1985	CA	1227526 A	29-09-1987
US 5720546	A 24-02-1998	NONE		
EP 035747	A 16-09-1981	CA	1149356 A	05-07-1983
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